Review Article

Garment dyeing

J N Chakraborty, Rudrajit Pal & P R Megha
National Institute of Technology, Jalandhar 144 011, India

Received 7 January 2005, accepted 31 March 2005

Garments are either prepared directly from processed fabric or the grey fabric is converted into garment followed by processing. Out of these two, the latter has gained undue importance to tackle present day scenario more effectively. This paper reviews the reasons behind this new challenge as well as other technical aspects related to dyeing of garments.

Keywords: Dyeing, Garment, Garment accessories

IPC Code: Int. Cl, D06P1/100, D06P3/00

1 Introduction

Garment dyeing procedure has seemingly proliferated itself in dyeing and finishing in recent years. Necessities of quicker fashion changes, reduction in final cost of production and a better aesthetic of dyed garment have enhanced the need for garment dyeing. Benefits of processing articles by garment dyeing procedure revolve around quick response and inventory control. Processing lead time has considerably been reduced by almost 33% through garment dyeing technique, since colour is added late in the apparel process chain. Augmentation of easy monitoring techniques, replenishment of stocks with newer trend and fashion, reduced level of stock holding, complete computerized control and bar coding have recently emerged out as additional features of garment dyeing technique. Major interest in garment dyeing has developed to service domestic market with exceptional speed of response as means of differentiating from traditional colouration provided by exhaust and continuous processes.

Endeavour of clothing industry is to have maximum flexibility in respect of colouration. Earnest of proper colouration, flexibility and other features conforming to the latest but short-lived fashion trends demand garment dyeing for production of quality garments, meeting the demands of customers exactly. Methods of garment dyeing have successfully been implemented towards dyeing of cotton and cotton mixture articles – knitted or woven, with some recent developments in processing of woollen garments. However, garment dyeing of acrylics, polyamides, polyesters and their blends has also evoked in the recent past. Current resurgence in garment dyeing from the point of view of garment processing industry has been because of (i) short pipeline necessary for quick response, (ii) reduced losses from dyed fabric waste, (iii) no subsequent shrinkage, (iv) lower energy, water and labour costs, (v) reduced inventory, (vi) ability to produce smaller batches, and (vii) production of uniformly dyed garments with no variation in shade at different parts of garments.

Structure of garment dyeing sector comprises conventional finishers, laundries/drycleaners and garment dyers. Garment dyeing activities can be divided into four groups, viz, (i) fully-fashioned garment dyeing by major commission dyers and finishers, (ii) cut and sew operations of garments covering woven and knitted fabrics dyed to high fastness standards, (iii) dyeing of pure cotton goods for ‘boutique’ trade with low colour fastness – only suitable for hand washing, and (iv) washing, desizing and bleaching denim goods, leading to stone washing, snow washing and over dyeing or highlighting effects. Cotton garments are supplied either in greige or prepared for dyeing forms. If the garment is in greige form, a full scour/bleach procedure is recommended while for PFD (prepared for dyeing) garments small amount of chemicals used to enhance garment manufacturing processes, such as softeners, antiscurl and lubricants, must be removed to ensure level dyeing. Proper preparation eliminates 60-70% of
dyeing problems. Garment processing concerns fabric manufacturing in greige mills with apposite knowledge, cooperation, coordination and feedback between the greige mills, preparation and finishing departments, cut and sews operators and garment dyers. Otherwise, umpteen processing problems in garment size control, appearance and texture may evoke due to immoderate shrinkage, variation in yarn size/twist, warp spacing in woven and courses/inch in knits. Moreover, the problems of shade non-uniformity, differences in fabric preparation, viz. desizing, scouring, bleaching, and shrinkage properties must also be considered. Stability of sewing threads, zips, buttons and other accessories are crucial considerations for subsequent garment processing.

2 Garment Dyeing Routes
Since late seventies and eighties, there has been a tremendous change in garment dyeing process, replacing traditional dyeing techniques where dyeing was carried out in fabric state prior to garment manufacture to associate better appearance and rheology to the merchandise. This has, to a great extent, enhanced the fashion look, appeal and comfort rendered by the merchandise and reduced lead time by leaps. In garment dyeing of woven fabrics, continuous preparation and drying of fabric is succeeded by its delivery to the garment manufacturer and then cutting and sewing of it to produce stock. The sale of the retail subsequent to dyeing and finishing of garment completes the process. Pretreatment of knitted fabrics is carried out in pre-relaxed condition followed by relaxed drying and their delivery to garment manufacturer. Definitely this has an advantage of short lead time of about 2 weeks, and the ability to respond to point of sale feedback for stock replenishment with dynamic response service has stimulated the growth of cotton garment dyeing in both woven and knitted fabrics as well as in multicomponent designs, incorporating woven and knitted panels. For fully-fashioned cotton garment, dyeing is slightly different from the case for multicomponent cut and sew garment. For knitted garment blanks, dyeing is preceded by make up and stock preparation. Garment passage continues till its sale through intermediate drying and finishing. Alternately, the process adopted has its path in which make-up of fine gauge knitwear is in latter stage. This considerably increases lead time to 5-6 weeks from 2-3 weeks in the prior route.

3 Garment Dyeing Techniques/Processes
In solvent dyeing technique, dyeing is eventually carried out using chlorinated hydrocarbons, e.g. per-and tri-chloroethylene in the form of emulsions or solvents. Solvent acts only as a medium to carry small quantities of water wherein dyeing process actually occurs. ‘Sancowad’ is a foam-dyeing method developed for dyeing at a liquor ratio as low as 2:1 using foam as the medium for dyestuff application. In this method, highly foaming detergents are used to provide dense foam from low quantities of water (within the machine) and water soluble dyestuffs are applied at very low liquor ratios. Temperature is then raised to impart a fixation treatment stimulating to some degree a pad/fix system. Detailed study on the dyeing processes for various types of garments has also been disclosed.

4 Garment Dyeing Machineries
The cotton garment dyeing can be affected through either traditional side-paddle machines or rotary-drum machines.

4.1 Paddle Dyeing Machine
In the side-paddle machines, there is slow circulation of both liquor and garments in a large vat by means of a rotating paddle. These machines have relatively low productivity and are slow in filling, heating, cooling and draining, giving rise to longer lead time and requirement of higher liquor ratio to facilitate circulation and levelness. One of the main limitations of paddle dye machine is lack of cooling facilities of dye bath which overcame in twin-paddle dyeing machines fitted with heat exchangers below the false bottom. Completely enclosed overhead paddle machines, recently developed, consist of horizontal cylindrical vessel with doors along the top sides and horizontal paddle extending the length of machine parallel to and along the axis of the vessel. Perforated and closed steam pipes are situated beneath a perforated false bottom. It is also featured with a circulating pump which withdraws hot liquor from below the false bottom and injects it through the jet positioned along the side of the machine, just below the liquor level to assist movement of goods.

4.2 Rotary Machine
Rotary machines consist of a horizontal perforated cylinder, radially partitioned into three or four
components, rotating with periodic reversal inside a stainless steel box holding dye liquor. Goods are loaded into the cage through sliding doors in the circumference. These machines are gentle in their action. Recent developments in these machines include addition of hydro extractors, re-inforced glass doors, variable cage speed and operation on a programmed automatic cycle in which liquor volume, time and temperature are fully controlled.\textsuperscript{16, 17}

### 4.3 Recent Developments

With the advancement of time, slowly the primitive laundry machineries, paddle and rotary dyeing machines, modified washer extractors, belly washers have been supplemented with automated and microprocessor controlled machines. Some of the attributes of ideal garment dyeing machines are the tilting mechanism, high temperature dyeing capability and centrifugal extraction. Further controls of indirect heating and cooling, variable speed control, water volume control and lint filters have also been implemented. Garment dyeing which was earlier a stepchild of wet processing industry has advanced into a unique art incorporating in it newer designs and features. Some of these are: (i) low liquor ratio, (ii) microprocessors for automated controlling, (iii) heat exchangers, (iv) lint filters, (v) centrifugal hydro extraction, (vi) easy sampling, (vii) pocketed drums, (viii) tilting mechanism – for easy loading and unloading, (ix) high temperature option, (x) large load sizes, (xi) cushioned suspension, (xii) variable drum speed, and (xiii) automatic balancing of drum.\textsuperscript{30}

During 1970s, developments in garment dyeing equipments were too many, viz. (i) side paddle machines with variable speed paddles and of variable length; (ii) ‘smith drums’ consisting of a rotating perforated drum normally with four compartments;\textsuperscript{5, 6} (iii) modified drycleaning units for solvent dyeing; (iv) dyeing machines with toroidal action developed originally from the Pegg K-type scouring and milling machines for woollen garments. Liquor is pumped up into a vessel containing garment carrier or plate and the liquid is deflected to the vessel circumference and then down into chamber with no mechanical assistance, movement being completely dependent upon the pumped action of water. Latest high temperature toroid dyeing machines work at liquor ratio as high as 40:1 to process 100% polyester fibre garments at 140°C (Ref. 32); (v) dyeing in foam-in-machinery specifically designed for ‘sancowad low liquor process’. Other developments included a centrifuging and drying operation as an integral part of dyeing machine.\textsuperscript{5, 15} However, advent of aqueous low liquor dyeing machinery with compromising liquor ratios of approximately 10:1 and flexibility to dye garments from all fibres led to obsolescence of this type of machinery, and (vi) centrifuging machines for rotary dyeing with integral centrifuging and short processing times lends itself ideally to the quick turnaround objectives in today’s market place.\textsuperscript{3}

Rotary dyeing machine has evolved out with considerable modifications every time in a more sophisticated and of modern version with the highlighting features, viz. (i) optical basket configuration in which selective pockets or baskets are available whose configuration affects the degree and type of mechanical action applied to garment;\textsuperscript{7} (ii) an external circulation which ensures maintenance of uniform temperature throughout the machine essential for critical fibres, like acrylics. It involves circulation of dye liquor through a filter to aid liquor-goods interchange, thus compensating for reduced agitation when running the cylinder at very low speeds. This protects the garment surface while allowing good penetration into seams and thick areas. An additional filter unit is used for removing loose fibres and lints to prevent redeposition of the same on garment. (iii) high speed centrifuge system ensuring that the moisture content is reduced to minimum, prior to drying operation without the need for additional handling and centrifuging in separate equipments in dyeing stage. Machines incorporated with centrifuge action have an added advantage of efficient rinsing in very short time, (iv) sophisticated heating and cooling with various means of accomplishing, e.g. direct steam injection into the dye liquor and addition of water directly to the machine suitable for simple dyeing processes; indirect heating and cooling by passing steam and water alternately through closed coils at the base of machine; indirect heating by means of a steam jacket around the body of the machine (cooling is done either directly or indirectly); and use of an external heat exchanger for indirect heating and cooling. Heat exchangers may work with steam, oil or high temperature hot water. Cooling may be done by direct addition of water or indirectly through heat exchangers, (v) flexible control systems urge the use of automatically regulated functions, process parameters, microprocessor control on centrifuging machines ensuring use of VDUs flow measurement. Technology requires advent of newer
paraphernalia including central control room with automatic addition of dyestuffs and chemicals from a central dispensing area, (vi) special sampling port during process without reducing liquor level. Inspection of an entire garment from the batch lot at sampling stage ensures proper assessment of shade, seam penetration, degree of milling and physical appearance. (vii) easy loading/unloading is obtained through tilting mechanism in which the garment has to be loaded directly from overhead feed arrangements and unloaded without manual handling into a conveyor system, (viii) variable cylinder speed during dye cycle ranging normally from 5 rpm to 35 rpm. This allows greater agitation at critical stages in dyeing process and less agitation to protect garment condition and maximize quality standards. (ix) high temperature processing of garments ensuring garment dyeing at temperatures up to 135°C, and (x) dye liquor recovery where spent dye liquor is transferred to a storage tank for reprocessing.

5 Selection of Dye for Cotton Garment Dyeing

Depending upon end uses of garment, the direct, fibre reactive, vat and sulphur dyes are used. Direct dyes, specifically classes A and B which have similar temperature of maximum exhaustion, are selected to ensure even application and higher reproducibility. At a dyeing temperature of 95°C, electrolyte is added to influence excess dye yield. Addition of calgon and a levelling agent is advisable for optimum results. Key application parameters for direct dyes involve dye bath exhaustion, rinsing and after-treatment. Special requirements of garment dyeing, viz. (i) good level dyeing properties, (ii) higher migration and diffusion properties to assist seam penetration, and (iii) suitability for short/automated process, have necessitated the use of reactive dyes. This requirement is met particularly with less reactive, monochlorotriazinyl dyes with their high temperature application to optimize diffusion and migration, low reactivity to optimize level dyeing and ease of automation using linear addition profiles for both dye and alkali additions. Further details of garment dyeing with fibre reactive dyes have been discussed elsewhere.

Vat dyes have limitations when severe chlorine fastness is required. Hot pigmentation technique is generally employed in which the dye is dispersed as an insoluble pigment under alkaline conditions at 60-80°C. After a levelling period, dye is reduced to leuco form and penetration into cotton fibre is affected. After flood rinsing at pH 10, reduced dye is oxidized back to insoluble form to achieve high wet fastness. Garment handling can be improved by cationic softener after-treatment.

Sulphur dyes represent a broad shade range, having good to excellent wash and light fastness at relatively low cost as compared to other dyeing systems. Black and medium to heavy shades of brown, blue and green are most commonly used; the range does include some fairly bright colours as well. Nowadays, liquid sulphur dyes, called sodyesul liquids, are used which offer excellent performance and economy in exhaust dyeing. These are much advantageous than fibre reactive dyes as these have lower costs, shorter dye cycle, better cotton coverage, and much less salt with comparable fastness properties. Sandoz antioxidant B, a sugar based reducing agent, results equally high reduction as sulphides. This allows an all-in procedure without the controls needed for sodyesul liquids. Presence of 20 ppm iron may alter dye yield and shade; presence of Ca and Mg also poses same problem. Sequestering agents, such as Sandoz Sulfaloxy 100, can overcome problem of weak dyeings, poor crocking and streaks caused by the metal contamination.

6 Pigment Dyeing of Cotton Garment

Though pigments are used in printing and pad dyeing since a long time, exhaust dyeing is a recent development. Being non-substantive in nature, binders are used to fix pigment on fibre surface. It was believed that the exhaust dyeing with pigments might not be practically possible due to low exhaustion and poor levelness. Development of suitable auxiliaries has lead to the induction of necessary affinity to fibres for pigments by pretreating textile for exhaust dyeing with pigments. Exhaust dyeing can be carried out in the following sequence: (i) prewashing, (ii) pretreatment, (iii) exhaustion, (v) stone washing (optional), (v) fixation, and (vi) thermo-treatment.

Impurities and contaminants are to be removed from garment through pre-washing to ensure best dyeing results. A critical part of dyeing sequence is pretreatment, where cotton is pretreated with a cationic compound to develop affinity for pigment—adequate uptake, and uniform adsorption of the cationic agent is essential for this purpose. During pretreatment, an ionic attraction is developed between pretreated fibre and aggregated pigment particles.
Exhaust dyeing is carried out in a pigment dispersion followed by binder fixation to improve fastness properties of garment as pretreated fibres so prepared have poor fastness property due to surface adsorption only. Stone washing, if required, is carried out before binder fixation. During thermo-treatment, binder polymerizes to form cross linkages to develop required fastness. Pigment dyeing procedure and related problems have also been disclosed in detail.

7 Anti-corrosion Techniques

Casual wears such as jeans are mostly incorporated with metallic components, like zips, buttons, rivets, and labels made up of brass/iron/copper/aluminum/zinc or magnesium. These can cause difficulties during garment dyeing. Peroxide bleaching is avoided to such prepared fabrics. Certain problems are encountered, such as dye resist mark or physical breakdown of the fabric, particularly in the area of direct contact with the metal component. Ferrous based materials have the risk of rust stains. Use of sequestering agent, such as EDTA, helps to prevent shade alteration due to chromophore sensitivity. Sandocorin 8160 protects the metal from reaction. The most satisfactory option is the use of nickel plated brass as metal component. Use of inhibitors based on phosphate ester/triazole gives the protection against metal component corrosion, although care should be taken to avoid the retardation of dye build-up.

8 Novel Effects in Garment Dyeing

Until the advent of stone washing, garment dyeing remained a relatively small and stable business. Where a worn-out or washed-out effect is desirable, the dyed material can be washed with or without stone addition before fixation. Oxidizing agents are applied to garments via stone soaked in reagents, resulting in modification of the colour of garments. Colour receptivity of garments can also be modified using cross-linking agents in finishing. Stone-washed cotton denim gives a fancy effect and a stylish look, which has changed the demand for garment dyeing in today’s market. ‘Ice washing’ is another technique for creating unusual colouring effects, where dyed garments are stone tumbled with chlorine or sodium permanganate-impregnated rock for a precise period of time and then treated in a sodium bisulphite bath. Different dyes, e.g. direct and reactive dyes, are affected differently by chlorine and sodium permanganate. Some dyes are discharged or totally destroyed by these chemicals. Various techniques of garment washing, optimization of parameters, enzymatic washing and various effects obtained including those for denim have already been reported.

Special exhaust type fabric softeners for dyed garment after-treatments have also been developed. These softeners are normally added to the last cycle to improve handle of finished garment and help to restore some physical properties which might have been reduced by certain dye processes. It is quite possible to cause a drastic change in look of dyed garments with foam finishing, post cure pretreatment, wrinkle resistant finishes, flock coating or high frequency fixation.

9 Woollen Garment Dyeing

Woollen garments in knitted form such as sweaters or hosiery are garment dyed. Recent development of woven woollen garment dyeing, such as rotary drum dyeing machines as well as side- and overhead-paddle machines has been reported. Machine washable fabrics are used to make garments which are to be dyed. Polyamide accessories used are also dyed with the same tone as that of woollen garment for complete matching. Common problems encountered during woollen garment dyeing are: (i) seam penetration, especially on pre-chlorinated garments where chlorination within the seams may be uneven, (ii) fibre damage during prolonged dyeing, (iii) reaching to the required level of colour fastness, and (iii) cockling effect on the garment. Metal complex, milling acid dyes, reactive dyes and chrome dyes, if properly used, can minimize these problems.

Specific dyeing auxiliaries used in woollen garment dyeing are: (i) acid-donor system, (ii) low temperature dyeing, (iii) after-treatment, and (iv) anti-felting agents. Informative reports have also been published on the criteria-based dye selection.

Felting tendency of wool poses some problem on garment dyeing as it leads to surface felting. Anti-felting protective agents are used in ‘over-dyeing’ to minimize surface distortion. Uses of anti-felting agents, like Meroplan NF (Chemische Fabrik Tübingen) and Nofelt WA (Tanatex), in woolen garment dye bath temporarily protects unchlorinated garments during dyeing and are removed during rinsing. Anti-felting agents are also used successfully in dyeing chlorinated lambs wool garments. Studies confirm that the inclusion of 1g/L
Nofelt WA in dye bath liquor improves wet bursting strength of untreated and chlorinated garment by reducing extent of chemical damage.

In latest developments, ‘Dylan GRB’ and ‘Hercoset’ shrink-resistant finishes have been introduced to meet the demand for machine washable woollen knit wears. These are based on application of resins to the surface of wool fibre after the latter has been modified by chlorination. Some reactive dyes have been introduced for wool to get adequate fastness and are restricted to reds, yellows, browns and intermediate colours only.

10 Polyester Garment Dyeing

Polyester fabric stability, aesthetic appeal and resistance to wear demand increase in use of textured polyester yarns for outer garments. Problems associated with dyeing polyester garments by carrier method recommend the use of HTHP dyeing, encouraging introduction of high-energy disperse dyes of improved fastness properties.

Comprehensive reviews give further information on the use of carrier and auxiliary chemicals in polyester dyeing, as well as dyeing of unmodified polypropylene garment with acid leuco vat dyes.

11 Quality Control

Boost in export of readymade garments essentially depends upon exceptional performance of garments. This requires maintenance of time schedule for shipments and production of high quality garments in order to improve piece realization. Production and marketing of high quality garments thus depend upon their conformation to rigid standards of export, compliance with the latest fashion changes, appropriate quality control and sale demand. ‘Price vs quality’ is a major aspect in this concern. Price of finished garment chiefly depends upon three factors, viz. history of the fabric turned into garment, technical inputs and use of appropriate processing machineries.

The major areas for quality control of garments are as follows:

11.1 Seams, Elasticized Areas, Waist Bands and Scuffs

These areas must be fairly loose, and seams should not be prepared taut otherwise this may lead to poor penetration of dyestuff in heavily swelling fibres. Possible remedy to this problem is the application of high temperature which results in better diffusion, penetration and running of cloth, facilitating liquid flow. This guarantees fruition of migration potential and is essential for multi-layered seams or elasticized waists. Normally, a temperature of 95°C is maintained before cooling for fixation.

11.2 Shrink Behaviour

Excessive or uneven shrinkage of garment where knitted and woven fabrics are mixed, leads to seam puckering. It is essential to prerelax knitted fabric and at the same time preshrink woven part. This is done by ensuring various shrink proof treatments for high quality garments.

11.3 Chafe Marks/Creases

These are defects developed particularly on delicate garments due to mechanical stress in drum dyeing machine, which degrade the final product. As a remedial measure, garments prone to chafe marks or pilling effect should be turned inside out and dyed in presence of non-foaming lubricant. Additional preventive measures may also be adopted by avoiding overloading of dyeing drum.

11.4 Accessories

Prudent choice of zips and metals accessories, such as buttons and studs, must be done to prevent their corrosion or breakage. Generally, ferrous metals are avoided and preference for nickel and its alloy is made unless bleaching or reactive dyeing is being carried out with high concentration of electrolyte or alkali. Choice for cellulosic buttons may lead to its undue breakage while polyester buttons are non dyeable and are used as neutral colours in coordination with umpteen shades. Nylon buttons can be coloured in subsequent dyeing process with excess effort. Ribs of garment are generally made of natural rubber or polyurethane such as lycra. These materials, on the other hand, have their own disadvantages. Natural rubber is affected adversely in the presence of certain metals like copper. In contrast, polyurethane articles are degraded by strong oxidizing agents like chlorine. A solution to these traumas is achieved by coating the metal accessories with corrosion protection agent. Sandcorin 8160 liquid, an anionic organic corrosion inhibitor, is an obvious choice as corrosion retardant. It prevents non-ferrous and white metals from oxidation and tarnishing by hindering the action of sensitive dyes onto the metal ions.

11.5 Sewing Threads

Sewing threads must be endowed with desirable properties, like strength and fineness to produce a neat seam and last for the whole life of the product.
Unmercerized cotton thread used in manufacturing of cotton garments produces a solid dyed inconspicuous seam. Polyester threads purposely enhance the effects in the seams due to their dye uptake resistance and mercerized cotton threads increase the dye uptake, resulting in darker appearance in shade. For cotton sewed garments meant for dyeing, it is not possible to switch-off directly from conventionally spun polyester or core-spun threads to 100% cotton threads and retain the same seam characteristics. Equivalent seam strengths can be obtained using heavier cotton threads. Similar degrees of elasticity in seam can be obtained by increasing stitch density. Seam puckering resulting from thread shrinkage during garment dyeing can be avoided by slacker stitches on lock stitch and chain stitch operations.

Selection of fibre for the preparation of thread depends on type of fabric to be sewed. Generally, a common selection is made for the thread used for fabric preparation and sewing. However, this is applicable mainly for cotton, as sewing threads made of other fibres do not possess affinity for cotton dyes. This unarguably hik es the cost of garment manufactured and the production speed.

11.6 Foreign Substances
Foremost objective of efficient garment dyeing is its value addition. This objective caters need for adaptation of preventive measures to hinder value loss of the article. Protection of garments from stains due to oils, greases and other lubricating agents is thus critical. Other foreign substances, like sizes and resins containing additives such as elastomers and oil repelling agents could also denigrate the appearance of garment.

11.7 Interlinings
Purpose of interlinings is to stabilize and enhance the appeal of outer fabric. With post-dyed garments, certain special properties has to be inflicted into the interlinings to ensure better performance. Special properties inherited by the interlinings include equivalent dye uptake by it as that of outer fabric. Moreover, the adhesive, bonding the outer fabric to the interlining, must remain intact during and after dyeing operation. Aftermath of dye sorption should not be adverse on colouration.

11.8 Care Labeling
Augmentation of fastness properties of dyed garments is essential for customers demand. Major attributes to be taken into consideration are: (i) dimensional stability, (ii) wash fastness, and (iii) rub fastness. To meet these parameters effectively, care labeling is achieved suitably which tells the customers precautions to be adopted while cleaning the garment. These care labels are embellished with specific instructions with respect to method of washing, bleaching, drying, ironing and suitability for dry cleaning. Various care labeling systems used are American, European, British and Canadian.

Quality level in garment dyeing can be augmented through proper fabric and dyestuff selection to survive the rigors of processing, proper sizing, effective training of the staffs to ensure skillful garment handling, good programming of dyeing equipments and innovations to increase production.

12 Recent Advancements in Garment Dyeing Sectors
Current resurgence in garment dyeing is probably because of the fidelity of the article to recently evolved quality control processes to adjudicate the loopholes. Certainly, the export of Indian readymade garment is becoming a more challenging job with the passage of time. This is reflected due to reversionary trend in American and European markets, restructuring of the world economy, disintegration of Soviet Union, emergence of China as a major world power, disturbances on internal and international front, increasing trade barriers, growing consumer awareness, rigid quality standards and recent ‘multifibre agreement’ followed by the abdication of ‘quota’ system from January 2005. ISO-9000 quality assurance certification and red listed chemicals are two new concepts required for enhancement of serviceability and quality of product. Red listed chemicals are hazardous pollutants which are accumulated on fibre during various processing phases.

13 Advantages of Garment Dyeing
There are several inherent advantages in garment dyeing, viz. (i) handling of smaller lots economically, (ii) unlimited selection of colour during dyeing, thus dyeing to order almost instantaneously, (iii) a specific product can be dyed in any number of shades, thereby increasing productivity, (iv) distress look with wrinkles, (v) full handle because of shrinkage during dyeing, (vi) quick turnaround at the retailer’s counter, and (vii) ability to respond quickly to the changes in the colour taste of the fastidious and fickle customers.
Cost justification of finished garment is an essential aspect of garment dyeing sector to add to its advantage. Major cost components in garment dyeing are: (i) dye and chemical costs, varying considerably upon shades, fibre and dye chemistry (ii) utilities primarily based on the cost of natural gas to heat water and determine dye-liquor ratio, and (iii) depreciation or labour 77, 78.

14 Problems of Garment Dyers

Most of the garments received by the garment dyers are cut and sewn from previously prepared cloth which aggravates certain problems, like (i) garment is cut from more than one piece of cloth and these different pieces have been prepared differently, (ii) garment has woven and knit pieces sewn together, (iii) garment has greige, prepared, bleached with optical whitener added, pieces all sewn together, and (iv) a finish, e.g. softener, resin, etc. has been added to the garment.

Preparation must be thorough, consistent and reproducible. This is extremely important since the cut and sew operation will need to be oversized keeping in mind subsequent shrinkage. Variation in preparation will result in inconsistency of final garment size after dyeing and drying.

The most common mistakes occur in garment dyeing are: (i) longer drying of goods resulting in wastage of energy and time, over drying and subsequent pilling, (ii) excessive heating, creating wrinkles and at very worst resulting in melting of goods, (iii) inadequate cooling down, (iv) insufficient loading to dryer, (v) not running dryer at constant production rate,(vi) unnecessarily long load or unload times, (vii) unclean filters, (viii) non-maintenance of seal of dryer. and (ix) inaccurate production and cost figures 79.

15 Limitations

In the backdrop of the advantages, there are certain limitations of garment dyeing. Even though the merits totally outweigh the limitations of garment dyeing, in the recent times it has plunged out to be a sensation. It is required to discuss the demerits too. The limitations of garment dyeing can be summarized as (i) complicated dyeing, (ii) high percentage of seconds and (iii) high dyeing cost 80.

16 Conclusions

Commercially, garment dyeing is a relatively newer field of textile processing. Till the recent past, there were no large scale ready made garment dyers in India and now it is time that large scale ready made garment manufacturers gradually switching over to garment dyeing after carefully studying the pros and cons. The advantage of garment dyeing lies in its flexibility towards the fast changing market, quick and beneficial response and rapid turnaround, flexibility towards dye shades, finish and lot sizes. Moreover, garment dyeing results in comparatively lesser rejections, requirements of lesser inventory, smaller capital investments and the chances of producing fancy and pristine effects. Thus, with the widening of the prospects of garment dyeing with further developments from the technological point of view, the fashion trends have become more dynamic and pristine. The end of quota regime after 2004 will open up new vistas for Indian Textile Companies as a repercussion already the stock markets are sniffing profits in the air. In 2004, the textile shares have definitely outperformed the indices by a safe margin. Certainly, newer versions of garments have evolved with exaggerated qualities and dynamic response. Thus, there would be an export bonanza for India in this quota free world.

References

16 Partridge H W, Rev Prog Color. 6 (1975) 56.